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ABBREVIATIONS

BMP	Best Management Practices
NGVD	National Geodetic Vertical Datum
OSHA	Occupational Safety and Health Administration
NRCS	Natural Resource Conservation Service
UDFCD	Denver Urban Drainage & Flood Control District
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation

REFERENCES

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- Arapahoe County, Colorado, The Flood Insurance Study Report for the City of Greenwood Village, December 3, 1993.
- Colorado Water Quality Control Commission, Regulation No. 61, Colorado Discharge Permit System, latest revision.
- Colorado Water Quality Control Commission, Regulation No. 72, Cherry Creek Reservoir Control Regulation, latest revision.
- Greenwood Village, City of, Wetlands Map. Field mapped by Bradley Miller, U.S. EPA, Denver, CO January 16, 1985.
- Soil Conservation Service, United States Department of Agriculture, Soil Survey Arapahoe County, Colorado, March 1971.
- Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3, latest editions.
- Water and Waste Engineering, Inc., Greenwood Village Drainage Criteria Manual, April 1999, revised March 2000.
- Wright Water Engineers, Inc., Major Drainageway Master Management Plan, City of Greenwood Village, Volumes I and II, March 1997.

DEFINITIONS

Base Flood - The flood having a one percent (1%) chance of being equaled or exceeded in any given year. Also known as the 100-year flood.

Floodplain - The relatively flat or lowland area adjoining a creek, gulch, drainageway, or other body of standing water which has been or may be covered temporarily by floodwater.

Floodplain Easement - That area which has been dedicated for the Special Flood Hazard Area.

Floodway - The channel of a creek, gulch, or other drainageway and the adjacent areas that must be reserved in order to discharge the base flood without cumulatively increasing the flood elevation more than one (1) foot or the energy grade line (EGL) elevation more than six (6) inches, whichever is less.

Land Development - Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, dredging, filling grading, paving, excavation, or drilling operations.

Local Drainage System - The Local Drainage System consists of curb and gutter, ditches, swales, storm sewer inlets, storm sewers, culverts, bridges, detention areas, and all other drainage facilities used to convey the minor storm and major storm runoff to the Major Drainageways.

Major Drainageways - Any channel with a tributary area of 130 acres or more.

Pre-Development Conditions - The condition of the land in a natural state prior to any development.

Regional Drainage Facilities - Regional Drainage Facilities include swales, ditches, culverts, storm sewers, Major Drainageways, detention facilities, water quality control features, and other drainage facilities designed to manage stormwater from more than one property.

Special Flood Hazard Area - The land in the floodplain of a Major Drainageway within a community subject to Flooding during the Base Flood.

Violation - Means the failure of a structure or other development to be fully compliant with these Construction Standards. A structure or other development without an approved Erosion and Sediment Control Plan, or other evidence of compliance with these Construction Standards is presumed to be in violation until such time as that documentation is provided.

Wetlands - Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands generally include swamps, marshes, bogs, and similar areas, though in the Village it can also include gulches, washes, Major Drainageways, and other areas that are not wet year round. The federal regulations defining wetlands and limiting activities which affect wetlands are found in 33 CFR Parts 320 through 330 and 40 CFR Part 230.

1.0 Sitework Permits

1.1 Introduction

Construction projects that change the landscaping near the property boundaries or within a drainage easement, that include grading activities, or that impact the impervious area shall be required to obtain one of the sitework permits, landscaping, grading, or flatwork, prior to construction. Examples of impervious area include buildings, patios, decks, driveways, sidewalks, and streets. Landscaping and grading activities can alter the existing drainage paths, thereby adversely impacting adjacent properties. Additional impervious area increases the runoff and can adversely impact the capacity of downstream drainage systems. Therefore, the City of Greenwood Village (Village) regulates these types of activities with three types of sitework permits.

1.2 General Provisions

- 1) For the purposes of this Manual, a construction project that changes the landscaping near the property boundaries or within drainage easements, that includes grading activities, or that disturbs the impervious area, is classified as Sitework. Sitework that meets the criteria below shall be required to obtain the appropriate permit:
 - a. Landscaping Permit: Sitework that includes landscaping or grading activities that:
 - i. Occurs within 10 feet of the property boundary, or
 - ii. Occurs within a drainage easement, or
 - iii. Disturbs more than 500 square feet, but
 - iv. Disturbs less than 10 cubic yards of soil or other material.
 - b. Grading Permit: Sitework that includes landscaping or grading activities that:
 - i. Disturb more than 10 cubic yards of soil or other material.
 - c. Flatwork: Sitework that includes:
 - i. Removal and replacement of at least 100 square feet of existing impervious area, or
 - ii. Addition of at least 100 square feet of new impervious area.
 - iii. Sitework that meets the criteria of a Landscaping Permit, but also meets the criteria of a Flatwork Permit as outlined above.

The existing impervious area is defined as the impervious area in existence when the property was initially developed or the area shown on the 1998 aerial photography, whichever is later. Any impervious areas added to the existing impervious area shall be considered as new impervious areas for all calculations.

- 2) The following activities shall not require one of the sitework permits:
 - a. Landscaping and grading activities that occur more than 10 feet from a property boundary and outside of a drainage easement, disturb less than 500 square feet of area, and disturb less than 10 cubic yards of soil or other material.

- b. Removal and replacement of less than 100 square feet of existing impervious area or the addition of less than 100 square feet of existing impervious area.
- c. Sitework that is authorized by other valid permits that have been issued by the Village. The scope and nature of the sitework shall be clearly defined on the approved plans for the other permits, and such activities shall meet all other requirements of this Chapter.
- d. Cemetery graves.
- e. Agricultural and gardening activities that do not change the shape or contours of the existing ground.
- f. Exploratory borings under the direction of a qualified registered professional engineer. However, test pits shall require either a Landscaping or Grading Permit, depending upon the amount of excavation.
- g. Sitework activities performed on an emergency basis by government agencies for the public health, safety, and welfare.
- h. Sitework activities performed as a part of a Village Capital Improvements Project.

1.3 Submittal Requirements

1.3.1 Permit Applications

A building permit application shall be completed for all types of sitework permits. A site plan must be submitted with the application. Sitework cannot begin until the application has been reviewed and approved by the City Manager or designee.

1.3.2 Contents of the Application

The application shall include the information shown in Table 1-1. The items marked with an “O” are optional depending upon the scope of the Sitework.

Table 1-1: Permit Application Checklist

Item	Landscape	Grading	Flatwork
1) Site plan	X	X	X
a. Plan of the proposed development shall be provided at a scale of 1" = 10' to 1" = 100'.	X	X	X
b. A topographic map shall be provided with two-foot existing and proposed contours tied to the Greenwood Village “Control Diagram” (Figure 2-1).	O	X	O
c. Property lines, easements and purposes of easements.	X	X	X
d. Streets.	X	X	X

Item	Landscape	Grading	Flatwork
e. Existing structures and improvements, irrigation ditches, Major Drainageways, and existing wetlands.	X	X	X
f. Proposed improvements, including impervious areas, plantings, delineation of grading activities, and erosion control measures.	X	X	X
g. Location and elevations of all floodplains affecting the property.	X	X	X
h. Location of all existing and proposed utilities affected by or affecting the Sitework.	X	X	X
2) Reports	X	X	X
a. Geotechnical report for foundation or retaining wall design or slope stability analysis.		O	
b. Sitework with a disturbed area of at least 10,000 square feet shall have an Erosion and Sediment Control Plan submitted in accordance with Chapter 3.	O	O	O
c. Sitework that disturbs at least 2,000 square feet and at least 10% of the existing impervious area or adds more than 500 square feet of new impervious area shall meet the flood attenuation and water quality management requirements of the Greenwood Village Drainage Criteria Manual	X	X	X

1.4 Sitework Inspections

The Village will perform several inspections of Sitework before, during, and after construction is completed. This is to ensure that projects are being completed in accordance with the approved site plan. Any changes that occur during construction shall be submitted for review and approval by the City Manager or designee. Sitework that requires an Erosion and Sediment Control Plan shall be inspected by the Owner's Representative in accordance with Chapter 3.0. The City Manager or designee will perform the following inspections for most Sitework:

- 1) Pre-construction Inspection – This inspection will be performed during the review of the permit application. Existing damage to public facilities will be documented.
- 2) Initial Site Stabilization Inspection – This inspection will be performed at the start of the construction to ensure that any erosion and sediment control measures shown on the approved site plan are in place prior to any activities that will expose the soil.

- 3) Periodic Inspections – These inspections will be performed at any time during the construction period.
- 4) Final Grading Inspection – This inspection will be performed near the end of the construction period to ensure that the any grading shown of the approved site plan has been followed.
- 5) Final Stabilization Inspection – This inspection will be performed at the end of the construction period to ensure that all disturbed areas have adequate ground cover. The final stabilization shall be completed before the project is considered complete.

1.5 Sitework Criteria

1.5.1 Excavations

All excavations that are a part of Sitework shall meet the following criteria:

- 1) Temporary cut slopes shall not be steeper than 2 (horizontal) to 1 (vertical), and permanent cut slopes shall not be steeper than 3:1.
- 2) Temporary excavations for foundations, utility trenching, and other improvements shall comply with all applicable safety regulations, including Occupational Safety and Health Agency (OSHA) regulations.
- 3) Adequate drainage facilities shall be constructed to protect all cut slopes against erosion or slope failure.

1.5.2 Fills

All excavations that are a part of Sitework shall meet the following criteria:

- 1) Fill slopes shall not be steeper than 3:1, unless a slope stability analysis has been prepared by a professional engineer licensed in the State of Colorado.
- 2) Fills shall not be constructed on existing slopes that are steeper than 2:1.
- 3) Existing slopes that are between 2:1 and 5:1 that are to receive fill material shall be benched prior to placement of fill.
- 4) Fill material shall be free of organic material. The material must also be free of rubble or rocks with a maximum dimension in excess of 12 inches unless a plan has been prepared by a professional engineer licensed in the State of Colorado.
- 5) Fill material shall be compacted to a minimum of ninety percent of Standard Proctor maximum density.
- 6) Adequate drainage features shall be constructed to protect all fill slopes against erosion or slope failure.

1.5.3 Slope Setbacks

In order to minimize the potential for damage to adjacent properties from sediment deposition or erosion, provide access for maintenance, and to blend the slope into the existing ground surface, the following slope setbacks shall be considered minimums:

- 1) Setbacks from the slope to the property or easement lines should be a minimum of 2 feet or;
 - a. At least 20% of the height of the slope at the top of the slope, but not greater than 10 feet.
 - b. At least 50% of the height of the slope at the bottom of the slope, but not greater than 20 feet.
- 2) Setbacks from the slope to structures should be;
 - a. At least one third of the height of the slope at the top of the slope, but not greater than 40 feet measured at the outer edge of the footing.
 - b. At least 50% of the height of the slope at the bottom of the slope, but not greater than 15 feet measured at the face of the building.

1.5.4 Erosion and Sediment Control

Erosion and sediment control measures shall be installed in accordance with Chapter 3.0 for all Sitework. The following initial site stabilization measures are generally required to be installed:

- 1) Silt fencing or other approved perimeter controls shall be installed downgrade of all disturbed areas.
- 2) Vehicle tracking control shall be installed at the construction entrance.
- 3) Additional measures as required by the City Manager or designee.

2.0 Inventory of Resources

2.1 Village Mapping Systems

Topographic mapping is available for most of Greenwood Village (Village) with a 2-foot contour interval. The topographic mapping was completed in 1998 and includes an inventory of landscaping, structures, streets, and various other planimetric features. The horizontal control for the mapping is the Colorado State Plane Coordinate system, and vertical control is NGVD 1929. This vertical datum is different from the NGVD 1988 that is used for floodplain mapping. Although the difference varies somewhat by location, for the Village the NGVD 1929 is approximately 3 feet lower than the NGVD 1988. Each section quarter corner has a designated control point. The mapping is available electronically or in hardcopy form in quarter sections. Figure 2-1 is an index for the mapping system.

Updated aerial photography is also available and can be used in conjunction with the topographic mapping. The date of the aerial photography is 2002 and it is ortho-corrected to minimize horizontal distortions in the photography. The aerial photography is available electronically and/or in hardcopy.

The Community Development Department maintains a list of sources from which the maps and aerial photography can be purchased.

2.2 Perennial Streams and Lakes

The Village has 6 perennial streams within its corporate boundaries. They are:

- 1) Big Dry Creek
- 2) Little Dry Creek
- 3) Greenwood Gulch
- 4) Prentice Gulch
- 5) Goldsmith Gulch
- 6) Cottonwood Creek

In addition, several areas drain directly into Cherry Creek Reservoir. Figure 2-2 shows the locations of the above listed drainageways that are located in the Village. This mapping is available from the Village in electronic and hardcopy forms.

2.3 Wetlands

The Village has mapping available of inventoried wetlands within the corporate boundaries. Typically, the wetlands are located in the Major Drainageways. The inventoried wetland boundaries have been superimposed on the aerial photography of the Village and provided on Figure 2-3. This mapping should only be used for planning purposes and does not constitute an

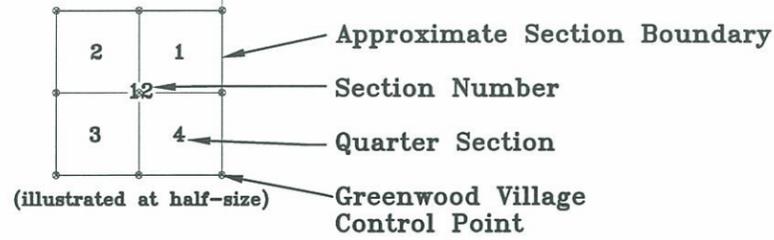
official wetland delineation. Chapter 14.0 of the Greenwood Village Drainage Criteria Manual specifies the requirements for proper wetland delineation. This mapping is available from the Village in electronic and hardcopy forms.

2.4 Soils Mapping

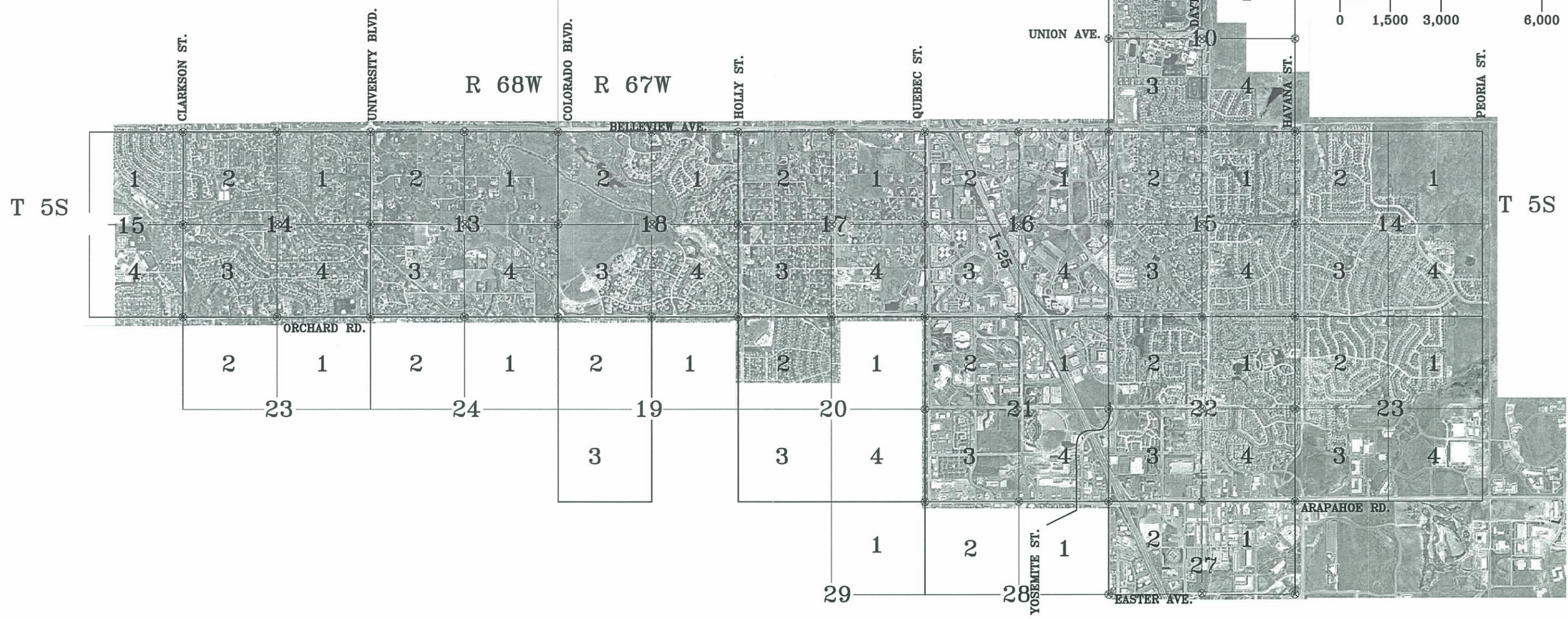
The soil types of the Village have been classified by the Soil Conservation Service and are presented in the Soils Survey of Arapahoe County. For convenience, the soil series in the Village have been grouped into three general soil types. Figure 2-4 shows the individual soil classifications and the composite classifications. This mapping should be used for planning purposes and can be referenced for design information unless the Village requires site-specific classification of soil type. Chapter 6.0 of the Greenwood Village Drainage Criteria Manual provides additional information regarding soil types and their relationship to runoff. This mapping is available from the Village in electronic and hardcopy forms.

2.5 Urban Drainage and Flood Control District

Urban Drainage and Flood Control District (UDFCD) is an important resource for completing erosion and sediment control plans for the Village. UDFCD has authored the Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3. The UDFCD Drainage Criteria Manual should be used concurrently with this Drainage Criteria Manual. However, when there are differences between the two manuals, the Greenwood Village Drainage Criteria Manual shall be used. Copies of the UDFCD Drainage Criteria Manual are available from UDFCD.



NORTH
 SCALE: 1" = 3,000'
 0 1,500 3,000 6,000



Greenwood Village
 Inventory of Resources
 October 2003

Figure 2-1
 City Mapping System Index

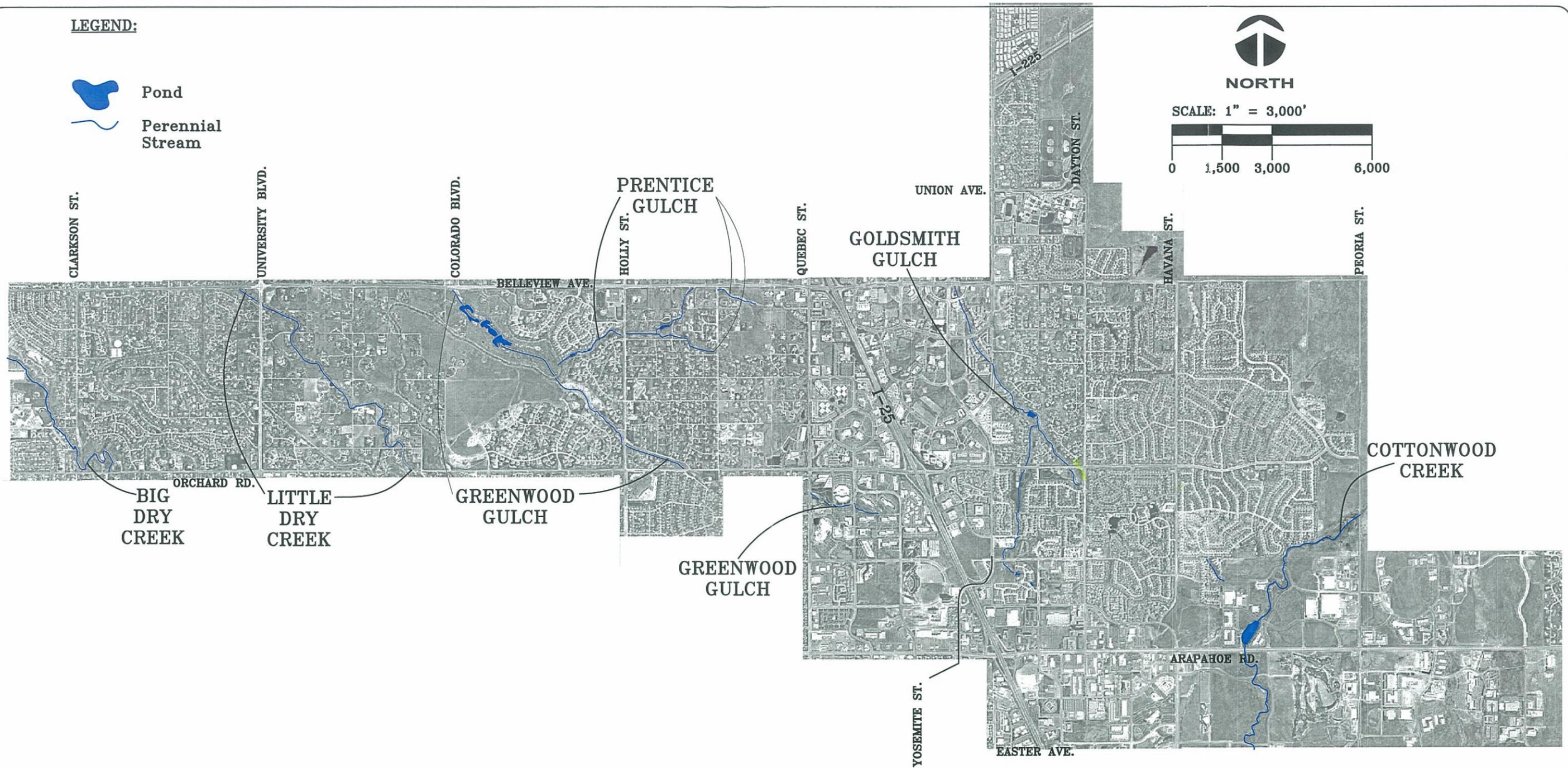
LEGEND:

-  Pond
-  Perennial Stream



NORTH

SCALE: 1" = 3,000'



Greenwood Village
Inventory of Resources
October 2003

Figure 2-2
Perennial Streams and Ponds

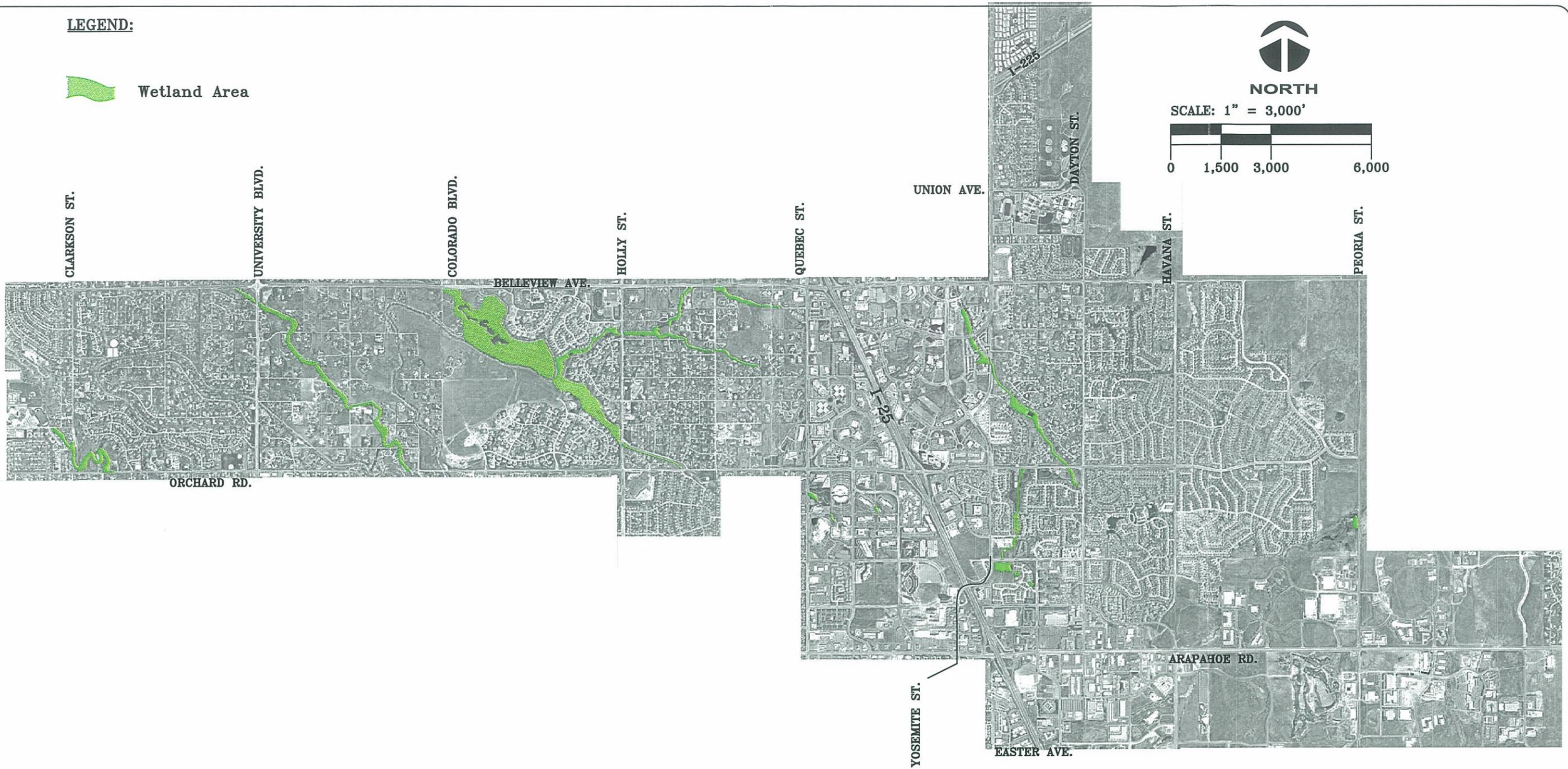
LEGEND:

 Wetland Area



NORTH

SCALE: 1" = 3,000'

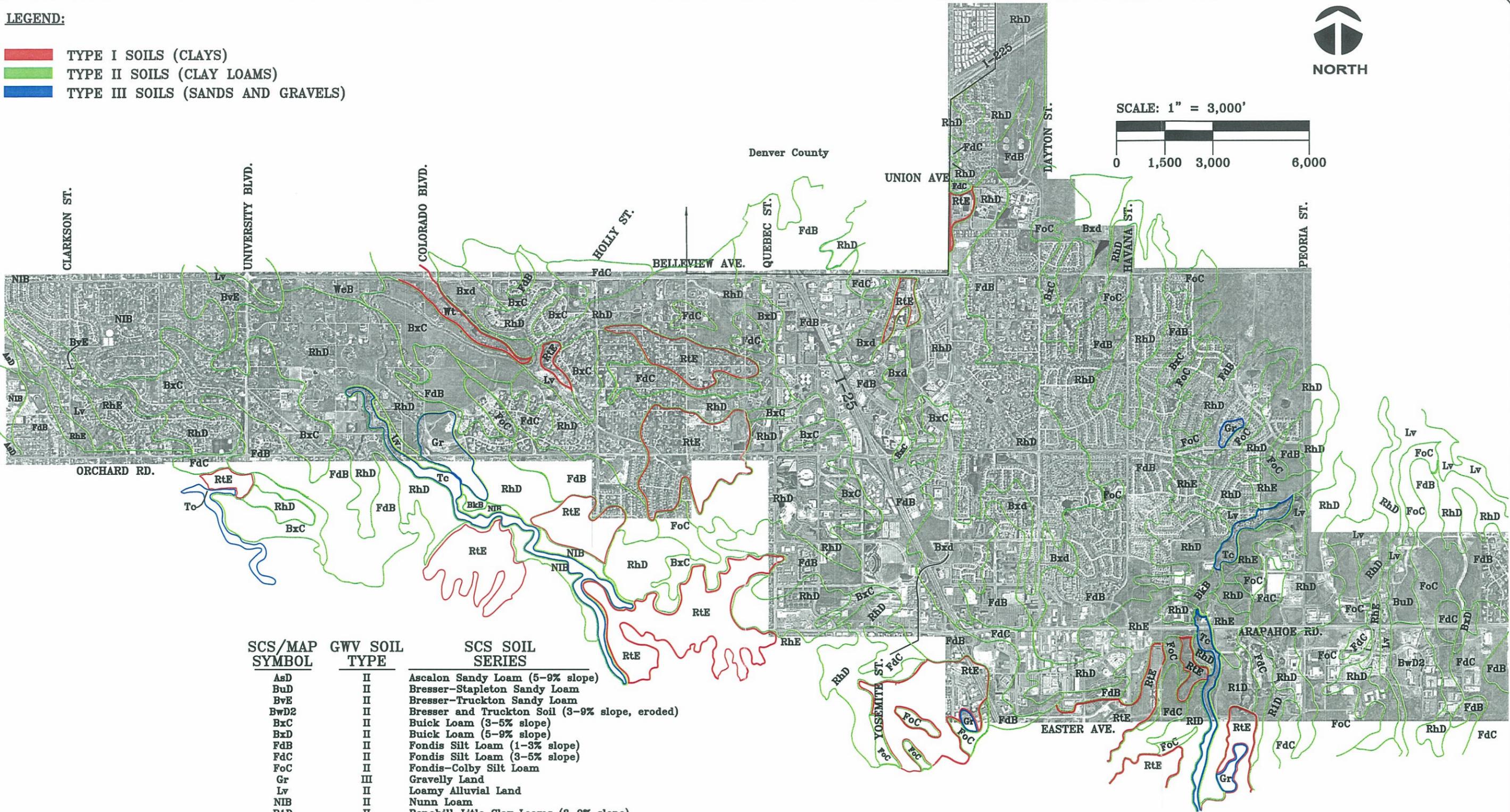
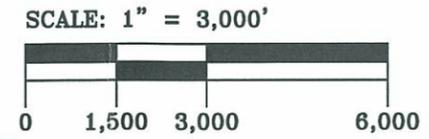


Greenwood Village
Inventory of Resources
October 2003

Figure 2-3
Inventoried Wetland Areas

LEGEND:

- TYPE I SOILS (CLAYS)
- TYPE II SOILS (CLAY LOAMS)
- TYPE III SOILS (SANDS AND GRAVELS)



SCS/MAP SYMBOL	GWV SOIL TYPE	SCS SOIL SERIES
AsD	II	Ascalon Sandy Loam (5-9% slope)
BuD	II	Bresser-Stapleton Sandy Loam
BvE	II	Bresser-Truckton Sandy Loam
BwD2	II	Bresser and Truckton Soil (3-9% slope, eroded)
BxC	II	Buick Loam (3-5% slope)
BxD	II	Buick Loam (5-9% slope)
FdB	II	Fondis Silt Loam (1-3% slope)
FdC	II	Fondis Silt Loam (3-5% slope)
FoC	II	Fondis-Colby Silt Loam
Gr	III	Gravelly Land
Lv	II	Loamy Alluvial Land
NIB	II	Nunn Loam
R1D	II	Renohill-Little Clay Loams (3-9% slope)
RdD	II	Renohill Loam (3-9% slope)
RhD	II	Renohill-Buick Loams (3-9% slope)
RhE	II	Renohill-Buick Loams (9-20% slope)
RtE	I	Renohill-Little-Thedalund
Tc	III	Terrace Escarpments (nearly vertical)
WeB	II	Weld Silt Loam
Wt	I	Wet Alluvial Land

Greenwood Village
Inventory of Resources
October 2003

Figure 2-4
Soil Classifications Map

3.0 Erosion and Sediment Control

3.1 Introduction

Disturbed lands include all those lands from which vegetation has been either temporarily or permanently removed. Examples of disturbed land include construction sites, corrals, confined animal feeding operations, and overgrazed lands. Disturbed lands are subject to substantial erosion and can be a source of significant discharges of sediment and other pollutants to wetlands and Major Drainageways.

3.2 Discharge Goal

Erosion and Sediment Control plans shall be prepared and implemented for areas of disturbance in excess of 10,000 square feet. Projects with disturbed area less than 10,000 square feet may still be required to provide sediment and erosion control measures. The plan shall be designed to minimize the discharge of sediment to Major Drainageways, wetlands, storm sewer systems, and adjacent properties. The Discharge Goal is described as follows: There shall be no discharge of more than 15 percent of the potential sediment load from disturbed lands for storm events smaller than a one inch rainfall within a one hour period to a Major Drainageway, wetland, storm sewer system, or across the property boundary, whichever is most restrictive.

The Discharge Goal will be achieved through the avoidance, wherever possible, of disturbing lands with slopes in excess of 15 percent and the use of recognized Best Management Practices (BMPs) and sediment ponds in all disturbed areas. The purpose of the BMPs will be to minimize the erosion of soil and the production of sediment at the source to the maximum extent practicable. The BMPs are assumed to control 50% of the potential sediment discharge from the site. The balance of the potential sediment discharge shall be controlled using sediment entrapment facilities.

3.3 Principles of Erosion and Sediment Control

Soil erosion is caused by the action of wind, rainfall, and runoff on bare soil. Clearing, grading, and other construction activities remove the vegetation and compact the soil, increasing both runoff and erosion. Excessive runoff then causes erosion and results in increased off-site erosion, discharges of sediment to streams, flooding problems, and damage to wetlands. Effective erosion and sediment control can be achieved by careful implementation of the following management actions:

- 1) Fit the development to the existing topography, soils, and vegetation.
- 2) Minimize disturbance and soil exposure by retaining natural vegetation, adopting phased construction techniques, and using temporary cover.

- 3) Vegetate and mulch all exposed areas to protect the soil from precipitation. The primary effort for controlling sediment pollution from construction sites should be to minimize raindrop impact on bare soil.
- 4) Utilize proper grading, barriers, or ditches to minimize concentrated flows and divert runoff away from exposed areas.
- 5) Minimize the steepness of slopes and control the length of slopes by utilizing benches, terraces, contour furrows, or diversion ditches.
- 6) Utilize riprap, channel linings, or temporary structures in ditches, swales, and channels to slow runoff velocities and allow the drainageways to handle the increased runoff from disturbed and developed area.
- 7) Keep the sediment on-site by utilizing sediment basins, traps, or sediment barriers.
- 8) Monitor and inspect sites frequently to assure the measures are functioning properly and correct problems promptly.

3.4 Erosion and Sediment Control Plans

3.4.1 Plan Submission

The Erosion and Sediment Control Plan must be submitted with the building permit application. For projects with a disturbed area greater than 1 acre, the proposed Erosion and Sediment Control Plan shall be certified by a professional engineer licensed in the State of Colorado. The certification will be bound into the Erosion and Sediment Control Plan at the time of submittal to the City of Greenwood Village (Village) using the following form:

I hereby certify that this Erosion and Sediment Control Plan for (name of site) was prepared by me or under my direct supervision in accordance with the Greenwood Village Construction Standards.

Signature

Colorado License Number

Seal

Construction or clearing of the site cannot begin until the Erosion and Sediment Control Plan has been reviewed and approved by the City Manager or designee.

3.4.2 Contents of the Erosion and Sediment Control Plan

For projects with a disturbed area less than 1 acre, the proposed Erosion and Sediment Control plan shall include, as a minimum, the information shown in Item 8, Maps, shown in Table 3-1.

For projects with a disturbed area of at least 1 acre, the proposed Erosion and Sediment Control Plan shall include, as a minimum, the information shown in Table 3-1.

Table 3-1: Erosion and Sediment Control Plan Checklist

Item
Engineer's Certificate
1) General Location and Description
a. Location
i. Local streets within and adjacent to the development.
ii. Township, range, section, and ¼ section.
iii. Major Drainageways, drainage facilities, perennial streams, and wetlands near the development.
iv. Names of surrounding developments.
b. Description of Property
i. Area in acres.
ii. Ground cover (type of trees, shrubs, and vegetation).
iii. Major Drainageways, drainage facilities, perennial streams, and wetlands within the development.
iv. General project description.
v. Areas of moderate or highly erodible soils.
2) Erosion and Sediment Control Design Criteria
a. Regulations
i. Discussion of compliance with or deviation from these Construction Standards.
ii. Discussion and justification of other criteria or methods used that are not presented in or referenced by these Construction Standards or UDFCD Drainage Criteria Manual.
3) Erosion and Sediment Control Design
a. General Concept
i. Discussion of existing drainage patterns that affect the control measure design.
ii. Discussion of proposed drainage patterns that affect the control measure design.
iii. Discussion of the content of tables, charts, figures, or drawings.
b. Specific Details
i. Discussion of each erosion and sediment control measure.

Item
ii. Discussion of the schedule of implementation for each erosion and sediment control measure used to meet the requirements of these Construction Standards.
4) Maintenance Plan
a. Maintenance Activities
i. Frequency of inspection.
ii. Repair and reconstruction of damaged measures.
iii. Cleanout and disposal of trapped sedimentation.
iv. Duration of maintenance program.
v. Final disposition of the measures when sitework is complete.
5) Conclusions
a. Compliance with Standards
i. Drainage Criteria Manual.
ii. UDFCD Drainage Criteria Manual.
b. Erosion and Sediment Control Concept
i. Effectiveness of facility design to control erosion and sediment.
6) References
a. Reference all criteria and technical information used.
7) Appendices
a. Erosion and Sediment Discharge Calculations
i. Calculation of average annual soil erosion rates without control measures for the entire area proposed for development.
ii. Sediment pond calculations.
8) Maps
a. General Location Map
i. A general location map showing the general drainage patterns around the property. The map should be at a scale of 1" = 1000' or 2000' and show the path of all drainage to and from any off-site basins. The map shall identify any development or facilities (i.e., irrigation ditches, existing detention facilities, culverts, and storm sewers) along the path of the off-site and on-site drainage.
b. Erosion and Sediment Control Plan
i. Map(s) of the proposed development shall be provided at a scale of 1" = 20' to 1" = 200' on 24" x 36" sheets.

Item
ii. A topographic map shall be provided with two-foot existing and proposed contours tied to the Greenwood Village "Control Diagram" (Figure 2-1). The topographic map shall extend a minimum of 50-feet beyond the property lines.
iii. Property lines, easements, and purposes of easements.
iv. Streets.
v. Existing drainage facilities and structures, including irrigation ditches, roadside ditches, gutters, culverts, Major Drainageways, and existing wetlands. All pertinent information such as materials, size, shape, slope and location shall also be included.
vi. Proposed type of street flow (i.e., vertical or combination curb and gutter), roadside ditch, gutters, and cross pans.
vii. Proposed storm sewers and open channels, including inlets, manholes, culverts, and other appurtenances.
viii. Location of each control measure.
ix. Details of control measures or reference to standard UDFCD details.
x. Location and elevations of all floodplains affecting the property.

3.5 Inspection, Maintenance, and Modification of Erosion and Sediment Control Plan

It can be anticipated that erosion control measures beyond those included in the Erosion and Sediment Control Plan will be necessary due to unforeseen circumstances or because the plan may not work as intended. For this reason, an inspection and maintenance program will be a necessary component of every Erosion and Sediment Control Plan.

The BMPs and sediment ponds shall be inspected by the Property Owner's Representative after each storm event. The actual performance of each BMP and sediment pond will be evaluated and compared with performance anticipated in the approved Erosion and Sediment Control Plan and any necessary maintenance will be completed within 24 hours. If the performance does not meet the goals of the Erosion and Sediment Control Plan, including the Discharge Goal, the BMPs and sediment ponds will be modified as necessary to meet the Discharge Goal within seven days. Modifications to the plan will be submitted to the Village for review and approval by the City Manager or designee within seven days of the stormwater discharge event which does not meet the Discharge Goal.

3.6 Estimating Potential Erosion and Sediment Discharge

3.6.1 Soil Classification

Soil classification provides a way to concisely express the general characteristics of different soils into groups or classes having similar properties. Soils include a wide variety of materials such as gravel and sand, clay mixtures deposited by glaciers, and the alluvial sands, silts, and clays in the floodplains of the Major Drainageways. Classification makes it possible to estimate performance by grouping soils with similar properties into the same class. Soil texture classifications developed by the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) are based on particle-size limits for sand, silt, and clay. The size of soil particles play an important role in the engineering properties and are more strongly influenced by surface forces than by gravity forces.

3.6.2 Calculation of Potential Erosion and Sediment Discharge

Soils that exist within the Village have been identified to assist the applicant in estimating the potential erosion and sediment discharge. The information used to develop the tables was obtained from NRCS Soil Survey Soils Maps, U.S. Geological Survey (USGS) Quadrangle topographic maps, and the NRCS Soils Inventory List for Arapahoe County.

The Universal Soil Loss Equation (USLE), Equation 3-1, consists of five factors. The ULSE provides a model for the prediction of erosion by water in areas where field measurements have not been made. Widespread field use of the USLE has substantiated its usefulness and validity for this purpose. Improvements in the USLE over the years have provided methods for predicting the effects of land uses, climatic conditions, and management practices on the potential erosion.

The erosion rate for a given area is determined from the combination of many physical and management variables. The USLE model predicts annual soil erosion rates even though short-time variables in specific storm events vary considerably from storm to storm. The USLE is:

$$A = (R) (K) (LS) (C) (P) \quad (3-1)$$

where: A = Computed spatial average soil loss and temporal average soil loss per unit of area, ton/acre/yr.

R = Rainfall-runoff erosivity factor. Defines the total annual erosive potential that is due to climatic effects. This factor reflects the impact of the geographical location on erosion, including lakes or mountain ranges, and the dominance of frontal or cyclonic activity. For the Village, R = 40.0.

K = Soil erodibility factor. Quantifies the susceptibility of soil erosion by water and predicts the long-term average soil loss that results from sheet and rill erosion. The erodibility factor, obtained experimentally, varies from 0.02 to 0.69 depending upon the NRCS soil classification. The erodibility factors for the Village range from 0.02 to 0.64 and are shown in Table 3-2. Figure 2-4 shows the locations for the different classes of soils in the Village.

- LS = Slope length and steepness factor. The effects of slope length and steepness have been evaluated separately in research; however, considering them as a single topographic factor in the field is more convenient. This factor represents the ratio of soil loss for a uniform slope length and steepness. Table 3-3 provides a LS value for a given length and steepness of uniform slopes for freshly prepared construction and other highly disturbed soil conditions with little or no cover.
- C = Cover-management factor. This is the ratio of soil loss from land cropped under specific conditions to the corresponding loss from clean-tilled soil that is left fallow on a continuous basis. Disturbed lands that remove the vegetation and leave the surface with minimal protection are comparable to continuous fallow conditions. So C = 1.0.
- P = Support practice factor. This is the ratio of soil loss with a specific support practice to the corresponding soil loss with upslope and downslope tillage. The impact of support practices for soil conservation planning on cropland would rarely have a counterpart on disturbed land areas. Because the slope length and steepness are accounted for in LS, P = 1.0.

Table 3-2: USLE Erosion Factor (K)

Map Symbol	Soil Series	Dominant USDA Soil Texture	Erosion Factor (K)
FoC	Fondis-Colby Silt Loam 3 to 5 % slope	Clay and silty clay loam, clay loam and silt loam, silt loam	0.43
BxD	Buick Loam 5 to 9 % slope	Loam to clay loam, sandy clay loam	0.37
BxC	Buick Loam 3 to 5 % slope	Loam to clay loam, sandy clay loam	0.37
Lv	Loamy Alluvial Land nearly level		0.37
RhE	Renohill-Buick Loams 9 to 20 % slope	Clay loam, loam to clay loam, sandy clay loam	0.37
RhD	Renohill-Buick Loams 3 to 9 % slope	Clay loam, loam to clay loam, sandy clay loam	0.37
Tc	Terrace Escarpments nearly vertical		0.37
RtE	Renohill-Little-Thedalund Complex 9 to 30 % slope	Clay loam, clay, silty clay loam	0.32
FdC	Fondis Silt Loam 3 to 5 % slope	Clay and silty clay loam, clay loam, silt loam	0.32
FdB	Fondis Silt Loam 1 to 3 % slope	Clay and silty clay loam, clay loam, silt loam	0.32
WeB	Weld Silt Loam 0 to 3 % slope	Silty clay loam to silty clay, silt loam	0.32
NIB	Nunn Loam 0 to 3 % slope	Clay, stratified sands and loams	0.28
be	Bresser-Truckton Sandy Loam 5 to 20 % slope	Sandy loam and sandy clay loam, sandy loam, loamy sand	0.24
Gr	Gravelly Land 6 to 50 % slope	Sandy loam, gravelly clay loam, gravel sand and silt	0.10
Wt	Wet Alluvial Land nearly level	Loam to sand, gravel	0.10

Table 3-3: USLE Slope Length and Steepness Factor (LS)

Slope %	Horizontal Slope Length (ft)																
	<3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	800	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.12	0.13
1.0	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.24	0.27
2.0	0.13	0.13	0.13	0.13	0.13	0.16	0.21	0.25	0.28	0.33	0.37	0.40	0.43	0.48	0.56	0.63	0.69
3.0	0.17	0.17	0.17	0.17	0.17	0.21	0.30	0.36	0.41	0.50	0.57	0.64	0.69	0.80	0.96	1.10	1.23
4.0	0.20	0.20	0.20	0.20	0.20	0.26	0.38	0.47	0.55	0.68	0.79	0.89	0.98	1.14	1.42	1.65	1.86
5.0	0.23	0.23	0.23	0.23	0.23	0.31	0.46	0.58	0.68	0.86	1.02	1.16	1.28	1.51	1.91	2.25	2.55
6.0	0.26	0.26	0.26	0.26	0.26	0.36	0.54	0.69	0.82	1.05	1.25	1.43	1.60	1.90	2.43	2.89	3.30
8.0	0.32	0.32	0.32	0.32	0.32	0.45	0.70	0.91	1.10	1.43	1.72	1.99	2.24	2.70	3.52	4.24	4.91
10.0	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72	3.09	3.75	4.95	6.03	7.02
12.0	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60	4.09	5.01	6.67	8.17	9.57
14.0	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48	5.11	6.30	8.45	10.40	12.23
16.0	0.39	0.49	0.56	0.62	0.67	0.98	1.64	2.21	2.73	3.68	4.56	5.37	6.15	7.60	10.26	12.69	14.96
20.0	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16	8.23	10.24	13.94	17.35	20.57
25.0	0.45	0.64	0.80	0.93	1.04	1.56	2.67	3.67	4.59	6.30	7.88	9.38	10.81	13.53	18.57	23.24	27.66
30.0	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55	13.35	16.77	23.14	29.07	34.71
40.0	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67	18.17	22.95	31.89	40.29	48.29
50.0	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42	22.57	28.60	39.95	50.63	60.84
60.0	0.63	1.07	1.47	1.84	2.19	3.36	5.97	8.37	10.63	14.89	18.92	22.78	26.51	33.67	47.18	59.93	72.15

3.7 Recognized Best Management Practices and Sediment Ponds

BMPs shall be used to minimize soil erosion and control at least 50% of the potential sediment discharges from the site. Several recognized BMPs can be used for this purpose. The applicant may also identify additional BMPs for consideration by the Village. It remains the responsibility of the applicant to ensure that the BMPs included in the Erosion and Sediment Control Plan will control at least 50% of the potential sediment discharges from the site. Normally, this will require the consideration of the following BMPs in the Erosion and Sediment Control Plan:

- 1) Scheduling,
- 2) Minimization of Disturbed Areas and Buffer Strips,
- 3) Grading to Minimize Erosion,
- 4) Surface Roughening,
- 5) Vehicle Tracking Control,
- 6) Temporary Diversion Dike,
- 7) Geotextiles,
- 8) Silt Fence Barrier,
- 9) Straw Bale Barrier,
- 10) Inlet Protection,
- 11) Rock Check Dam, and
- 12) Revegetation (including timeline for seeding and mulching.)

The balance of the potential sediment discharge shall be controlled using sediment entrapment facilities.

The design of the BMPs and sediment entrapment facilities shall be in accordance with the criteria presented in the Construction BMPs Chapter, Volume 3 of the UDFCD Drainage Criteria Manual. Detailed design criteria and design procedures specific for the Village are highlighted in the following Sections.

The design policy of the Village is to provide guidelines that are consistent with regional stormwater drainage policy. The guidelines are intended to serve as a minimum standard and are not intended to replace site-specific analysis and design requirements of individual projects.

If one or more of these BMPs are not included in the Erosion and Sediment Control Plan, the certifying engineer must include a specific rationale for its exclusion. Cost alone shall not be considered an adequate reason for exclusion. Adequate reasons for exclusion could include:

- 1) Absence of any discernible drainage channels or all drainage channel slopes are less than 1%.
- 2) Absence of drop inlets.
- 3) Absence of surface slopes in excess of 2%.

3.7.1 Scheduling

DEFINITION: Scheduling is the sequencing of the project activities to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking. The schedule is a listing of all land disturbing activities together with the necessary erosion and sediment control measures planned for the project. This schedule guides the contractor on work to be completed before other work is started so that erosion and sedimentation problems can be avoided.

PURPOSE: The work schedule coordinates the timing of land disturbing activities and the implementation of control measures and is perhaps the most cost-effective way of controlling erosion during construction. The removal of ground cover leaves a site vulnerable to erosion. Construction procedures that limit clearing, provide the timely installation of erosion and sediment control measures and restore ground cover can significantly reduce the erosion potential of a site.

DESIGN CONSIDERATIONS:

- 1) Design project to integrate into existing land contours.
- 2) Schedule major grading operations during dry months, allowing enough time before rainfall begins to stabilize the soil with vegetation or to install temporary sediment control measures.
- 3) Locate temporary soil stockpiles and staging areas to minimize additional land disturbance.
- 4) Practice erosion and sediment control year round, erosion may be caused by unexpected precipitation, wind, and vehicle tracking.
- 5) Apply perimeter control measures.
- 6) Schedule projects that disturb only small portions of the site at any one time, complete grading as soon as possible, and immediately stabilize the disturbed portion before starting the next phase.
- 7) Close and stabilize trenches as soon as possible.

TYPICAL SCHEDULE: A typical schedule shall include the following deadlines as a minimum:

- 1) Silt fencing and vehicle tracking control: prior to initial grading activities.
- 2) Sediment ponds: initial phase of grading activities.
- 3) Seeding and mulching: within 15 days from completion of grading activities.
- 4) Inlet/outlet protection: within 1 week after inlet installation.
- 5) Straw bale check dams: within 1 week after completion of swale or ditch grading.

3.7.2 Minimization of Disturbed Areas and Buffer Strips

DEFINITION: Minimizing disturbed areas and maintaining buffer strips retains the natural vegetative cover and maintains vegetative buffer strips near wetlands, Major Drainageways, and adjacent properties.

PURPOSE: Minimizing the amount of disturbed soil on the project site will decrease the amount of soil which erodes from the site and decrease the number of required control measures. Buffer zones are used to decrease the velocity of runoff, which in turn helps to prevent soil erosion.

DETAILS:

- 1) Designate areas of no disturbance. Clearly show on the plans and flag or fence in the field areas of no disturbance and vehicle exclusion.
- 2) Designate and protect trees and shrubs that are to be preserved.
- 3) Designate wetland and Major Drainageway buffer strips.
- 4) Maintain and preserve riparian and naturally vegetated buffer strips along wetlands, Major Drainageways, and other natural channels.
- 5) The width of a buffer strip between the disturbed area and the protected area is 50 feet plus four times the slope of the land in percent, measured between the edges of the disturbed area and the protected area.

3.7.3 Grading to Minimize Erosion

DEFINITION: Grading to minimize erosion is the contouring of slopes to lessen the impacts of surface erosion and runoff.

PURPOSE: Careful grading will minimize the erosion potential and encourage ground cover establishment. Generally, grading to minimize erosion will not be necessary if slopes are less than 3%.

SLOPE CONTOUR FURROWS:

- 1) Stair-step grade or groove cut slopes that are steeper than 4 (horizontal) to 1 (vertical).
- 2) Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some soil are particularly suited to stair-step grading.
- 3) Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical portion.
- 4) Do not make individual vertical cuts more than 2 feet high in soft materials or more than 3 feet high in rocky materials.
- 5) Groove the slope using machinery to create a series of ridges and depressions that run across the slope at the same elevation.

3.7.4 Surface Roughening

DEFINITION: Surface roughening is a technique to shallow groove a bare soil surface by normal tilling, disking, harrowing, or tracking with construction equipment.

PURPOSE: Surface roughening is intended to reduce runoff velocity, increase infiltration and provide for sediment trapping.

INSPECTION AND MAINTENANCE: Periodically check the seeded slopes for rills and washes. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

3.7.5 Vehicle Tracking Control

The vehicle tracking control shall be used on all sites that have the potential for vehicles to track sediment off the site. Access that crosses a curb shall include a stepped wood ramp to protect the curb. Gravel or dirt ramps are prohibited.

3.7.6 Silt Fence

Silt fencing shall be placed downgrade of all disturbed areas that have the potential for sediment to be transported off the site by runoff. Projects with small areas of disturbance may have the bottom of the fence anchored on top of the ground using gravel or dirt. A minimum of 9" of the bottom of the fence shall be so anchored.

3.7.7 Sediment Entrapment Facilities

For locations with a tributary area less than 1 acre, a silt fence or other barrier may be used to create the sediment entrapment facility. For locations with a tributary area of at least 1 acre, a sediment basin shall be used to create the sediment entrapment facility.

4.0 Construction Site Facilities

4.1 Introduction

All construction sites on private property within the Village are required to have sanitation and construction waste facilities and utilize safety measures. The sanitation and construction waste containers are intended to reduce the impact of construction sites on adjacent properties by providing adequate sanitation facilities for employees and accessible containers for construction waste. The safety measures are intended to decrease the potential risk to the general public around the construction site.

4.2 Sanitation Facilities

Adequate sanitary facilities shall be provided on construction sites for employee use. Sanitary facilities shall not be located in the public right-of-way or closer than five feet from a side or rear property line. Sanitary facilities shall be screened and/or located in a location that is the least visible to adjacent properties. An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required to access facilities that will require removal by vehicles.

Non-sewered portable toilets must be available to workers during the “active construction process” (i.e. from preparation for footings until completion of building construction). If there are inactive construction periods of one month or more when no workers are on sites served by the unit, toilets are not required during such times. Portable toilets shall be placed at least one hundred (100) feet from any body of water and installed in such a way as to insure that there is no possibility of a spill or run-off into any body of water. Portable toilets shall be screened and/or located in a location that is the least visible to adjacent properties. Owners of property containing portable toilets are responsible for maintaining the portable toilets in a sanitary and odor-free condition at all times.

4.3 Construction Waste Facilities

Adequate construction waste facilities shall be provided on construction sites. Dumpsters, garbage cans, waste containers, and other similar types of containers shall be used to contain solid waste. Liquid waste and hazardous materials shall be contained and disposed of at a proper waste depository.

Construction waste facilities shall not be located in the public right-of-way or closer than five feet from a side or rear property line. Construction waste facilities shall be screened and/or located in a location that is the least visible to adjacent properties. An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required to access dumpsters and other facilities that will require removal by vehicles.

Runoff from concrete truck wash-out into the public right-of-way, drainageway, wetland, storm sewer system, or across a property line is prohibited. Concrete truck wash-out must be contained on-site or hauled off-site and disposed of at a proper waste depository. Prohibited runoff from concrete truck wash-out is considered an illicit discharge.

4.4 Materials Storage

Materials storage area(s) shall be designated on construction sites. Materials are not allowed to be stored in the public right-of-way. An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required for all materials storage areas and the access to those areas. Storage containers shall not be located in the public right-of-way or closer than five feet from a side or rear property line, shall not block access, shall not exceed the height of an allowed accessory structure, and shall be located in areas of the least visibility.

4.5 Construction Trailers and Signs

Construction trailers shall be located on the same lot as the construction, shall not be located in the public right-of-way or closer than five feet from a side or rear property line, and shall not exceed the height of an allowed accessory structure. Construction trailers shall be screened and/or located in a location that is the least visible to adjacent properties.

An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required to access construction trailers. All trailer areas shall be policed on a regular basis to maintain the area in a neat and orderly condition. A construction trailer is only to be used for construction business supporting the construction project.

Construction signs denoting architectural, engineering, or construction firms engaged in work on a construction site shall be limited to one per trailer, shall not exceed 24 square feet in area, and if ground mounted, shall not exceed four feet in height.

Trailer Removal - Construction trailers shall be removed from the site when the last structure for which the trailer is permitted has been constructed and occupied, or within 10 days after the construction activity has ceased, whichever occurs first. After a construction trailer is removed from the site, the grounds shall be restored to the condition they existed prior to trailer installation.

4.6 Sales Trailers/Sales Offices

Sales trailers/offices shall be located within the subdivision where the sales are taking place, shall not be located in the public right-of-way or closer than five feet from a side or rear property line, and shall not exceed the height of an allowed accessory structure. Sales trailers shall be screened and/or located in a location that is the least visible to adjacent properties. All sales trailers shall be serviced by a temporary potable water supply and a temporary sewerage system as approved by the Village. An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required to access construction trailers.

Sales trailers shall be handicap accessible as required by ASCI. All trailer areas shall be policed on a regular basis to maintain the area in a neat and orderly condition. Trailers located in a residential area shall be skirted with a fire retardant material, and shall be screened or located in location not obtrusive to adjacent properties. The maximum number of sales trailers is limited to one (1) per Subdivision/ Development. Signage shall be limited to one per sales trailer, shall not to exceed 24 square feet, and if ground mounted, shall not exceed four feet in height.

Trailer Removal - Sales trailers shall be removed from the site when the last lot is sold, or after three years, whichever occurs first. An extension can be granted to removal as allowed by the City Manager or his/her designee. After a construction trailer is removed from the site, the grounds shall be restored to the condition they existed prior to trailer installation.

4.7 Construction Fencing

Fencing shall be provided for below grade construction in excess of 30 inches that is unattended at any time or open overnight.

4.8 Emergency Access

Vehicle access for fire fighting and other emergency vehicles shall be provided within construction sites. Vehicle access shall be provided to within 100 feet of temporary or permanent fire department connections. In addition, vehicle access shall be provided to within 150 feet of the outside of any building under construction or demolition.

Vehicle access shall be provided by either temporary or permanent roads or drives with a minimum width of 20 feet and shall meet the turning requirements of the local fire department. The vehicle access shall be an all weather surface capable of supporting the appropriate vehicle loading as required by the local fire department.

Key boxes or other means of access shall be provided for all gates along the vehicle access route.

4.9 Parking

When possible, on-site parking for employees shall be provided at construction sites. Parking on public and private streets is allowed when adequate on-site parking is not available. However, the parking shall be managed to minimize impact to adjacent properties and shall not obstruct vehicle access for fire fighting and other emergency vehicles. An all weather surface that meets of the requirements of Vehicle Tracking Control in Section 3.8.5 is required for all on-site parking areas and the access to those areas.

Vehicle access on the adjacent public or private streets shall maintain a minimum width of 20 feet and shall meet the turning requirements of the local fire department.